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Processing microalgae suspension propagated in flat panel photobioreactors

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Driven by the rising need for biofuels and by the necessity to capture carbon dioxide, autotrophic organisms got into the spotlight of energetic research. With cultivation of these organisms we can feed back the carbon content of CO_2 into biological systems and we can get numbers of valuable organic compounds, among others biofuel, to reach ecological and economical benefits.

We have studied the technology of algae cultivation and processing at the Department of Chemical Engineering at the University of Pannonia. The utilization of alga cultures in experimental photobioreactors were examined, together with the optimization of the operational conditions both for artificial and natural light and with different fertilizers. We made extraction experiments of dried algae.

We use special flat type photobioreactors (PBR) to keep specified cultivation parameters.

These algae suspensions must be well stirred, because degradation might be started in subsided algae conglomerate. These reactors must be designed for local microclimate and mostly mounted with cooling system. We use quasi-continuous systems. In this case part of the culture is harvested and restored with fresh medium. It is important to avoid the proliferation of harmful microbes and important to monitor the accumulation of metabolites.

The harvested suspensions are concentrated and dried. The concentration method consist generally two steps. First is the flocculation and the second is filtration. We are test the applicability of membrane separation processes which may be promising solutions of this problem.

Next step is drying. We dry the algae cake 65°C to avoid of the cells boiling. Milling can be also an important step if the algae cake were dried in blocks.

Extraction can be carried out in two strategies. One of them is to extract oil from dry or moist material. The latter can be made by ultrasonic, microwave radiation, chilling shock, cell blast, enzymatic process. The aim of these methods that let intracellular compounds achievable for extracting material. But they can cause solvent-separation problems.

The most important goal is to get the best yield with the lowest investment of materials and energy. We compared effects of algae growing parameters by achievable extract yields. It is cleared, that changing one parameter can cause beneficial effect. But on the other hand there can be changes in the bioreactor which may cause unfavorable consequences.

A possible experimental path which has not been described in detail above is GMO. The introduction of which to industrial production has possible benefits, but also needs caution in order to prevent the natural ecosystem.

The other important question – as for all novel processes – is the rate of return. At this point the utilization of the algal-oil is not sufficient on its own, but the alga cells contain compounds that can be used in pharmaceutics (carotinoids), biogas synthesis (starch, sugars) or even in the agricultural industry (micro and macro elements).

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